EARTH OBSERVATION SYMPOSIUM (B1)
Earth Observation Sensors and Technology (3)

Author: Dr. Michaela Musilova
Slovak Organisation for Space Activities (SOSA), Slovak Republic, musilova@sosa.sk

Mr. Ondrej Závodský
Slovak Organisation for Space Activities (SOSA), Slovak Republic, zawin@svetelektro.com
Mr. Jakub Kapuš
Slovak Organisation for Space Activities (SOSA), Slovak Republic, jakub.kapus@sosa.sk
Mr. Rudolf Slošiar
Slovak Organisation for Space Activities (SOSA), Slovak Republic, rstrudy@gmail.com
Dr. Miroslav Mocak
Slovak Organisation for Space Activities (SOSA), Slovak Republic, miroslav.mocak@gmail.com

VERY-LOW-FREQUENCY RADIO WAVES DETECTOR IN THE FIRST SLOVAK SATELLITE SKCUBE

Abstract

skCube is the first satellite completely designed and built in Slovakia, which will be sent to outer space in 2016. It is a 1U cubesat and its development started 6 years ago by engineers brought together by the Slovak Organization for Space Activities (SOSA). At the time, their research and technological goals were focused on the development and launching of cubesat-like payloads attached to meteorological balloons into the Earth's stratosphere. They were designed in a modular fashion, and equipped with communication/navigation systems and sensor platforms. This technology was further developed, with multiple enhancements, and incorporated into the skCube over the past 4 years. Although this satellite's mission is primarily focused on public outreach, it will also be able to measure very-low-frequency (VLF) radio signals. These signals can be used to analyse the Earth's magnetosphere and electric discharges in the atmosphere.

The VLF receiver consists of a square-shaped air-core coil antenna, commonly known as a magnetic loop. An operational amplifier amplifies the signal from the coil. The signal is then delivered to an internal analog-to-digital (AD) converter in a microcontroler, which subsequently processes it. Its digital filtration, Fourier analysis and event detection, based on a power flux density, is performed directly on-board the satellite. The receiver works in 2 modes. The first slow one allows for the monitoring of the evolution of spectral changes throughout skCube's orbit and the detection of potential anomalies. The second mode executes very fast sampling of the detected signal, based on an excess of power flux density over specific limits. It will allow for the analysis of fast events occurring in the upper parts of the Earth's atmosphere.

Space-born detectors with magnetic loop antennas have the advantage of being sensitive in the VLF radio band, which is very interesting from a scientific perspective. Moreover, they are small and can be easily placed on the printed circuit boards of cubesats. However, our receiver seems to suffer from the proximity of internal electronics, hence boosting electromagnetic noise to a higher level. The pros and cons of our design have been thoroughly analyzed, and gave us ideas how to improve our technology for future space missions. SOSA is currently planning on using skCube for the measurements of electric discharges originating in the atmosphere and solar storms. Furthermore, SOSA is also keen on collaborating with other researchers/institutions interested in using the VLF and other skCube data.